substantially threaded designated as leading portion and second one which can be internally threaded or smooth, designated as regulating portion; at least two relatively interchangeable ports - one inlet port and one outlet port in fluid communication with said regulating portion of said tubular space and being separated longitudinally by internally threaded or smooth cylindrical surface;

b) a cylindrical stem having at least two substantially different portions longitudinally on its surface: first one - substantially threaded with the same pitch as said body and congruently engaged with said body threaded surface thereof designated as leading portion and second one which can be smooth or threaded, proliferating longitudinally into said second portion of the body between said inlet and outlet ports designated as regulating portion;

c) said leading portion of said stem having zero backlash fit with congruently engaged body leading portion thereof defining leading thread capable to move longitudinally said stem into said regulating body portion upon rotation of said stem and said regulating portion of the stem being threaded or smooth is engaged threadedly or slidably with corresponding said regulating portion of said tubular space;

d) at least one of the mutually engaged said regulating portions of said tubular space and said regulating portion of said stem is substantially threaded;

e) at least one of said substantially threaded surfaces has its thread substantially truncated with tapering truncation - for the internal thread, from the major diameter of internal thread to the diameter equal or lesser than minor diameter of internal thread and for the external thread, from the major diameter of external thread to diameter equal or lesser than minor diameter of external thread;

f) said mutually engaged regulating body portion and said regulating stem portion defining at least one spiral backlash or groove along said tapering truncated thread and said backlash or groove being with tapering cross-section;

g) said tapering cross-section defining tapering flow passage between said inlet and outlet ports and said cross-section of said tapering flow passage being a function of the length of said stem engaged between said two ports therefore function of rotation of said first part of said stem into said regulating portion of the body;

h) said stem having conical or ogival front part adjacent to said truncated threaded portion and said front part extended beyond said outlet port when said stem fills completely said space between said inlet and outlet ports and can seal hermetically a sit with corresponding shape defined into said tubular space;

i) said stem having a means for rotation mounted on extended out of said body part of said stem, so that by rotation of said means, said stem will axially move into the space between said inlet and said outlet ports, whereby providing full range of flow regulation from "shut-off" position when said stem completely fills said space, then very "low flow" position along the backlash capillary channel when said stem is partially removed from said space, then "moderate flow" position said stem is inserted only partially into said inlet port by said front portion and "full flow" position when said stem with said front portion is removed completely and said space is full with fluid.

11. The valve as set in claim 10 wherein said leading and regulating portions of said stem are separated by smooth cylindrical part which is slidably fitted into corresponding smooth bore inner portion of said body whereby to provide fluid tightness of the assembly between said leading portions of said stem and said body and said regulating portions of said stem and said body.

12. The valve as set in claim 10 wherein said smooth cylindrical portion of said stem has grooves for o-rings whereby to isolate fluidly said leading from said regulating portions of the valve.

13. The valve as set in claim 10 wherein said body of the valve is composed from more than one coaxial mounted portions whereby to provide easy assembly, accessibility and maintenance.

14. The valve as set in claim 10 wherein in said regulating portion of the body is formed annular space around said regulating part of said stem and said annular space has a cross-section substantially close to that of the fluidly connected to it inlet port.

15. The valve as set in claim 10 wherein said stem has a portion extended out of said body assembly designated to be connected with means for regulation further comprising:

a) a handle for rotation of said stem;

b) a micrometric scale for measuring the degree of that rotation and therefore degree of the insertion of said regulating portion of the stem into said regulating portion of said tubular space.

16. The valve as set in claim 10 wherein the diameter of said inlet and outlet ports is substantially the same or smaller compare to the diameter of said inner tubular space and more particularly to said regulating portion of the tubular space thereof.

17. The valve as set in claim 10 wherein said conical or ogival front portion of said stem completely seals said inlet/outlet port when being axially pressed to corresponding congruently shaped sit adjacent to said inlet/outlet port.

18. The valve as set in claim 10 wherein said regulating part of said stem is designed as a sabot tightly fitted to the stem and having same shape and function as said regulating part; said sabot is engaged within said regulating portion of the body; said sabot is made from material with low coefficient of friction - one of group including nylon, molybdenum sulphide filed nylon, PTFE, PTE, polypropylene whereby enhancing the operation ability and easing the maintenance.

19. The valve as set in claim 10 wherein said regulating portion of the body is designed with tightly fitted insert having same shape and same functions as said regulating portion of the body and said stem has its regulating portion engaged with said body insert and said body insert is made from material with predetermined low coefficient of friction - one of group including nylon, molybdenum sulphide filled nylon, PTFE, PTE, polypropylene whereby enhancing the operation ability and easing the maintenance.

The Objection to the Claim Rejections – 35 USC 112

Claim **9** is rejected under 35 USC 112 as being indefinite for failing to particularly point out and distinctly show the subject matter which applicant regards as his invention. Claim 9 is rewritten and the presumed parts which are novelty and their functions are separated in two claims 18 and 19.

In Claim 18 Applicants claim sabot on the regulating portion of the stem, made from material with low coefficient of friction enhancing the operation-ability and easing the maintenance. The claim is based on Fig.6 and specification: *[0087]* ***FIG. 6*** *represents an embodiment allowing easy manufacturing by casting or injection molding of the fine regulating sabot* ***21*** *having tight press-fit over the stem* ***20****. This sabot can be changed during regular*

*maintenance of the valve not interfering with the integrity of the other more expensive parts of the valve. Appropriate material for the sabot **21** is a plastic or metal alloy with low coefficient of friction.*

Claim 19 specifically claims the insert in the regulating part of the body made from material with low coefficient of friction enhancing the operation-ability and easing the maintenance. The claimed design and feature are based on Fig.9, Fig.10 and respectively on the specification: *[0090]... The body-insert **22B** has to be machined in fine and accurate manner from different but compatible with the body material as self-lubricated plastic or metal.* And further; *"The surface of this portion is sealed by the pressure over the packing seal 27 being part of body-insert **22B.** The body-insert is made from above mentioned material with low coefficient of friction – nylon, molybdenum sulphide filled nylon, PTFE, PTE, polypropylene or alike".*

The two main features resulting from this design are:

a) easy maintenance and change of the insert;

b) additional seal provided between stem 20D and insert 27 by tightening bonnet 24 into the body 22.

Applicants assumed that as far as there are no any new materials added to the specification and the drawings, the existing material is adequate to be in the base of aforementioned claims.

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The Objection to the Claim Rejections – 35 USC 102

Claims **1-2, 4, 7 and 9** of the present invention are rejected under 35 USC 102(b) as being anticipated by Marino, Jr. et al. US 4,634,434.

In response to this Office Action applicants argue that those claims cannot be anticipated for many particular reasons as they are shown hereinafter:

Applicants state that there is common prior art before Marino's patent which have in use helical groove and are cited by Marino and others. As far as the use of helical groove has been known in the state of the art, any particular changes in the shape, pattern and cross-section of such groove formed between two main parts – the stem and the body of the valve, not cited in the previous art and leading to new features, can be consider farther improvement and more particularly invention.

In Marino's patent the drawings Fig.3, Fig.4 and Fig.5 representing the core of the invention teaches **for only one surface in the body** which is threaded in order to move the member

with helical groove and another smooth barrel part designated for regulation. This is confirmed in the specification, col.2 lines 23 to 25 "In the device of present invention, the helical groove is disposed upon longitudinal flow regulating member, and means are provided for moving the member longitudinally..." and further on lines 31 to 34 "For example, the means for adjusting the position of the longitudinal member may take the form of **a screw movement**..." The second portion of Marino's stem is definitively designated as ***smooth*** cylindrical regulating member with helical groove, aforementioned Fig. 3, 4 and 5, which is the core of his Claim 1. Formally and by matter Fig.1, Fig.2, Fig.4, Fig.5A, Fig.5B, Fig.6, Fig.7 and Fig.9 of the present invention show the difference. In all of them the regulating portion of the body and the stem are grooved with congruently **engaged threads of the body and the stem,** therefore different by shape and engagement from Marino's patent.

Further in Marino's Patent the regulating part of the stem is smooth cylinder covered with helical groove. This groove is not formed as threaded line in standard thread but **changes its peach** considerably and this is a part of the regulating model described by Marino et al.

One skilled in the art can see depicted on Figs. 1, 2, 3, 4, 5-A, 5-B, 6, 7 and 9 of the present invention **that the regulation portion of the body 22 A is threaded and engaged with threaded by the same pitch part of the stem and this pitch is the same as the pitch of the moving part of the body and the stem.** The defined cross-section of the groove (grooves) in the present invention changes simultaneously (increases or decreases) with the engaged length of the thread (Fig.4 and Fig.5). The grooves defined between crest and roots of engaged parts in a standard thread can have extremely small or zero cross-section increasing to the full cross section of the truncated standard thread. As far as both parts of the thread on the stem and on the body can be truncated, such cross-section can be doubled.

Thus the differences between Marino's patent and present invention are:

a) Constructive; standard thread with the same pitch for the moving and regulating parts in the present invention v/s not standard helical groove with changing pitch in Marino's patent;

b) Functional; cross-section of the groove gradually changing with engaged length in the present invention v/s square groove which changes by pitch and depth in Marino's patent; The regulation in Marino's patent is limited to the maximum cross-section of the engaged groove. The regulation in the present invention includes four transitionally connected steps. In Marino's patent one skilled in the art will see that once the large part of the groove reaches the inlet port, the flow rate will jump uncontrollably. In the present invention the flow is controlled in four gradually interconnected transitional steps seen on Fig.1 and explained on

Fig.4–A to 4-D and further in specification – paragraphs [0080] to [0084]. Each of those steps resemble some basic art such as limited orifice, capillary restricted flow, needle valve and conical shut-off valve, however they function together with smooth transition to each other. **This fact is the base of the name of this invention Hybrid Flow Metering Valve.**

c) Technological; the valve upon present invention has many technological advantages – threaded stem easy can be reproduced with standard machine shop equipment whereas the stem upon Marino's patent cannot be easy mechanically manufactured without special highly sophisticated equipment.

d) Overall performance; regulation with valve upon present invention easy covers difference in fluid flow with four to five and even more orders of magnitude, for example starting with air flows in mikrolliters per minute and going to hundreds of liters per minute at the same differential pressure.

On Fig.3, Fig.8 and Fig.10 of the present invention a non threaded portion of the body is engaged with the threaded stem. There is a misleading similarity with Marino's stem. As one skilled in the art can see in all depicted figures of the present invention, the thread of the stem **does not change its pitch as in Marino's patent,** but changes the cross-section of the helical groove only by changing the dept of the groove. Upon the present invention this groove is connecting the full open inlet port, or special annular space connected fluidly with fully opened inlet port, with fully opened outlet port of the valve. The fine regulation does not require shrinking the inlet port to smaller cross-section as one depicted on Fig.3 and Fig.4 of Marino's patent - outlet tubular member 15 having smaller inlet opening 20. Marino's patent therefore fails to show feature of broad span of fine regulated fluid flow, full bore opening and minimum flow resistance. Comparing to Marino's patent the total shape and shut-off function of the valve upon present invention explained by the drawings Fig.3, Fig.8 and Fig.10 and paragraphs [0080] to [0084] lead to broadest possible flow rate regulation **without jump in the flow** as seen in Marino's patent.

The novel physical features of Claim 10 produce new and unexpected results hence are unobvious and patentable over these references under Paragraph 102.

Based on all aforementioned, applicants request reconsideration and withdrawal of objection since constructively, functionally and by achieving another advanced feature, the present invention significantly defers from referenced art. Claim 10 therefore recites novel physical unobvious features not claimed and not achieved in the prior related art.

The Objection to the Claim Rejections – 35 USC 103

Claim **3** is rejected under 35 USC 103(a) as being unpatentable over Marino, Jr. et al. US 4,634,434 in view of Phillips US 4,601,310.

Marino's patent does not disclose grooves in the stem. Phillips discloses grooves in the stem for O-rings. The Office Action states that it would be obvious to make grooves in the stem of Marino as disclosed by Phillips in order to seal the stem from leaking fluid.

Applicants already distinguished heretofore the present invention from related art, more particularly from Marino's patent. The present invention applied O-rings over the stem which by construction, function and features is a novelty compare to the other stems known for this type of art. The use of O-rings well known as leak tightening devices is patentable over the background of common knowledge in case of Phillips, because of its novel function with specially designed stem and sleeve in needle type valve.

As a parallel to Phillips, the present invention applies O-rings over a novel constructed stem which could not be obvious by the time of previous art and is patentable over Marino in view of Philips.

Applicants request reconsideration of this objection as recited construction and feature have been unobvious at the time of invention.

Claims **5** and alternatively 1 are rejected under 35 USC 103(a) as being unpatentable over Marino, Jr. et al. US 4,634,434 in view of Magnasco US 5,141,027.

Claim 5 is replaced by claim 14 emphasizing particular design leading to previously claimed feature. Claim 14 teaches annular space in the specified regulating portion of the body which has substantially close cross-section to the cross-section of the inlet port and connected fluidly with this inlet port. The claim of the present invention is based on the design depicted on Figs. 1, 2, 3 and 8. The annular space **45** around the stem connected to the inlet port provides smooth transition of the flow from the opening from the groove of the rotating stem to the inlet/outlet port. The annular space improves considerably all regulating process as seen in the specification [0089]..." *The annular space **45** around the stem **20** connected to the port **41** helps very high flows to be handled with considerable accuracy*".

As far such annular space is not a subject of the prior art and this feature is combined with the feature of novelty designed stem, Applicants therefore submit this claim as overcoming the related art and more particularly Marino's patent in view of Magnasco.

Claim **6** is rejected under 35 USC 103(a) as being unpatentable over Marino, Jr. et al. US 4,634,434 in view of Callahan, Jr. et al. US 3,428,291.

Applicants agree that Marino lacks a scale for measuring the degree of rotation. A micrometric means for measuring degree of rotation and/or axial linear movement are widely used in fine mechanics and are used for the same reason in the device of Callahan for regulation of needle valve being novelty by applying bellows around the stem. As a parallel the present invention apply micrometric scale in a new device with very high precision of adjusting the position of the groove axially in order to make regulation repeatable and reproducible. In the present case once the novelty of the stem and the body of present invention is proved, there is no reason given in O.A. to support the proposed combination between Marino's and Callahan's teachings.

Applicants consider therefore that the newly designed stem and body are coming with new features unobvious in the prior art and therefore unobvious at the time of invention. Applicants request reconsideration and withdrawal of the rejection.

Claims **8**, and alternatively **1**, are rejected under 35 USC 103(a) as being unpatentable over Marino, Jr. et al. US 4,634,434 in view of McDonnell US 3,841,354.

Applicants already proved heretofore the evident difference between Marino's patent and present invention. One of the most significant differences between any prior art and present invention is the entire shape of the stem after present invention. In all Figures of present invention one skilled in the art can see that the entire stem has in general conical and/or ogival front shape in order to provide smooth transition in the regulating space from the fine cross-section of the capillary to regulation of the formed annular space around front part of the stem (completely different from claimed annular space in claim 14), therefore claimed conical/ogival part is combined with threaded part of the stem to lead to a new feature - extremely large interval of regulated fluid flows. Claimed conical/ogival shape hence has flow regulating function; from zero flow (shut-off) to maximum flow v/s mentioned in McDonnell's patent single shut-off function which is a functional feature.

Thus Applicants request reconsideration and withdrawal of this objection.

Conclusion

For all of the above reasons, Applicants submit that the claims are now in proper form, and that the claims all define patentably over the prior art. Therefore they submit that this application is now in condition for allowance, which action they respectfully solicit.

Conditional Request for Constructive Assistance

Applicants have amended claims of this application so that they are proper, definite and define novel structure, which is also unobvious. If for any reason this application is not believed to be in full condition for allowance, applicants respectively request the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. paragraph 2173.02 and paragraph 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without need of further proceedings.

Very respectfully,

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2005 July 18 ----------

Gueorgui Mihaylov, Applicant